Canadian Journal of Cardiology 32 (2016) 369–377

Clinical Research

The Association Between Conversion to In-centre Nocturnal Hemodialysis and Left Ventricular Mass Regression in Patients With End-Stage Renal Disease

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ABSTRACT

Background: In-centre nocturnal hemodialysis (INHD, 7-8 hours/session, 3 times/week) is an increasingly utilized form of dialysis intensification, though data on the cardiovascular benefits of this modality are limited.

Methods: In this prospective cohort study, we enrolled 67 prevalent conventional hemodialysis (CHD, 4 hours/session, 3 times/week) recipients at 2 medical centres in Canada, of whom 37 converted to INHD and 30 remained on CHD. The primary outcome was the change in left ventricular mass (LVM) after 1 year as assessed by cardiac magnetic resonance imaging. Secondary outcomes included changes in serum phosphate concentration, phosphate binder burden, haemoglobin, erythropoiesis stimulating agent usage, and blood pressure.

RÉSUMÉ

Introduction : L'hémodialyse nocturne en centre (HDNC), qui consiste en des séances de 7 à 8 heures 3 fois par semaine, est une méthode de plus en plus utilisée pour intensifier la dialyse; or, les données relatives à ses bienfaits sur la santé cardiovasculaire demeurent encore limitées.

Méthodes : Dans le cadre de cette étude de cohorte prospective, 67 patients traités par hémodialyse traditionnelle (HDT) (séances de 4 heures, 3 fois par semaine) dans 2 centres médicaux canadiens ont été admis. De ces patients, 37 sont passés à l'HDNC, tandis que les 30 autres ont poursuivi l'HDT. Le critère d'évaluation principal était la variation de la masse ventriculaire gauche après 1 an, évaluée par résonance magnétique cardiaque. Les critères d'évaluation

Patients with end-stage renal disease who receive chronic dialysis continue to have unacceptably high cardiovascular morbidity and mortality.[1] Interventions that mitigate cardiovascular risk in the general population have been found to be of limited benefit when applied to dialysis recipients, suggesting a unique pathophysiology of cardiovascular disease that may be caused or exacerbated by the dialysis procedure itself.[2-4]

The role of dialysis intensification for attenuation of cardiovascular risk is of growing interest. Dialysis intensification can be organized in a variety of schedules and settings, home- or facility-based.[5-7] Because left ventricular hypertrophy is a well-established predictor of adverse cardiovascular events[8,9] and regression of left ventricular mass (LVM) is associated with improved cardiovascular outcomes in both the

Received for publication May 16, 2015. Accepted July 5, 2015.

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See page 376 for disclosure information.

http://dx.doi.org/10.1016/j.cjca.2015.07.004

Results: Conversion to INHD was associated with a 14.2 (95% confidence interval [CI] 1.2-27.2) g reduction in LVM as compared with continuation on CHD. This result was maintained after adjustment for baseline imbalances between the groups and in ancillary analyses. There was a trend toward a larger drop in systolic blood pressure (9.8 [95% CI, −1.4-20.9] mm Hg) among INHD recipients with a significant reduction in the number of prescribed antihypertensive agents (0.7 [95% CI, 0.3-1.1] agents). Serum phosphate declined by 0.40 (95% CI, 0.16-0.63) mmol/L among INHD recipients without any difference in calcium-based phosphate binder requirements, as compared with those who remained on CHD.

Conclusions: Compared with continuation of CHD, conversion to INHD was associated with significant LVM regression and reduction in serum phosphate concentration at 1 year.

Résultats : Le passage à l'HDNC a donné lieu une réduction de la masse ventriculaire gauche de 14,2 g (intervalle de confiance [IC] à 95 %, 1,2-27,2) par rapport à la poursuite de l'HDT. Ce résultat est demeuré le même après les ajustements apportés aux données initiales des patients afin d'équilibrer les groupes et les analyses additionnelles. Les patients traités par HDNC ont obtenu une plus importante réduction de leur pression artérielle systolique (9,8 mm Hg [IC à 95 %, -1,4-20,9]), ce qui a entraîné une diminution significative des ordonnances d'antihypertenseurs (0,7 agent [IC à 95 %, 0,3-1,1]). Toujours chez les patients traités par HDNC, le taux de phosphore sérique a diminué de 0,40 mmol/l (IC à 95 %, 0,16-0,63), mais aucune différence n'a été relevée en ce qui a trait aux besoins en chélateurs de phosphore à base de calcium par rapport aux patients qui avaient poursuivi le traitement par l'HDT.

Conclusion : Comparativement aux patients qui avaient poursuivi le traitement par l'HDT, les patients qui étaient passés à l'HDNC ont présenté une régression significative de leur masse ventriculaire gauche et une diminution de leur taux de phosphore sérique après 1 an.

general[10,11] and dialysis[12] populations, the change in LVM has been the primary endpoint of randomized controlled trials evaluating intensified hemodialysis regimens.[7,13,14]

Despite the potential benefits of dialysis intensification such as improvement in endothelial function,[15] many patients may have significant psychosocial, physical, or cognitive barriers that preclude home hemodialysis that is currently used by only 4% of the prevalent dialysis population in Canada.[16-18] In-centre nocturnal hemodialysis (INHD), delivered 3 times/week and for 7-8 hours per session, presents a unique opportunity for dialysis intensification without the burdens of self-care.[19] However, there is a paucity of information regarding the impact of INHD on cardiovascular health.

We conducted a 2-centre prospective observational study with the primary objective of characterizing the association between INHD conversion and changes in LVM, as evaluated by cardiovascular magnetic resonance (CMR) imaging.

Methods

Participants

Patients on CHD (3-4 hours/session, 3 times/week) for at least 90 days who converted to INHD at St Michael's Hospital (Toronto, Canada) and St Paul's Hospital (Vancouver, Canada), both university-affiliated tertiary care centres, were eligible for participation if they were willing and able to have CMR. In the absence of clinical practice guidelines to inform indications for INHD, primary reasons for recommending conversion to INHD included refractory hyperphosphatemia, intradialytic hypotension on CHD limiting volume removal, labile blood pressure on CHD, and preservation of employment opportunities. The patient and treating nephrologist jointly made the decision to convert to INHD. Exclusion criteria were serious comorbidity with life expectancy < 1 year, planned kidney transplant from a live donor in the coming year, contraindications to CMR, and confirmed pregnancy. We recruited a control group comprising individuals who met the eligibility criteria as described but who elected to remain on CHD with no anticipated conversion to INHD. We attempted to identify patients with matching characteristics to the INHD converters based on age (within 10 years), gender, and duration of end-stage renal disease (within 3 years). The Research Ethics Boards of each site approved the study, and all study participants provided written informed consent.

Administration of dialysis therapies

INHD was administered 3 times/week for a planned duration of 7-8 hours/session. Blood flow was 300 mL/min and dialysate flow 500 mL/min. Dialysis machines (Phoenix, Gambro, Richmond Hill, ON, at St Michael's Hospital, and Dialog$^+$, B. Braun, Bethlehem, PA, at St Paul's Hospital) and dialyzers (Xenium 210, Baxter Healthcare Corp, McGraw Park, IL, at St Michael's Hospital, and Rexeed 21S, Asahi, Memphis, TN, at St Paul's Hospital; both are high-flux dialyzers with a surface area of 2.1 m^2) were not changed after INHD conversion. All patients in the CHD arm continued on their previous dialysis prescription. All fundamental aspects of hemodialysis care conformed to prevailing guidelines during the study period and did not differ by study arm.[20]

Study outcomes

The primary outcome was the change in LVM as measured by CMR at 1-year follow-up. All CMR examinations (except for 1 patient who could not fit into the 1.5 T scanner, a 3 T scanner was used) were performed with a 1.5 T scanner using a phased-array cardiac coil and retrospective vectorocardiographic gating. A standardized protocol that was used for measurement of LVM has been previously published.[21] All CMR postprocessing and LVM measurements were performed offline by a blinded experienced reader (A.T.Y.).